

# **NUCLEAR POWER IN FINLAND**

**Mariehamn 22.6.2010**

**Ulla Klötzer, Women Against  
Nuclear Power**

*Background information*

- **Loviisa 1 (1977) and 2 (1981)**  
VVER Russian reactors, owned by Fortum (state owns a little over 50 %)
- **Olkiluoto 1 (1979) and 2 (1982)**  
ABB reactors, owned by TVO (owned by the industry) aiming at producing electricity at self cost price
- both plants have **underground final repositories for low and intermediate level waste** (at the Baltic Sea coastline)

- **Posiva** responsible for final spent fuel repository (owners Fortum/TVO)
- **all spent fuel now stored in water pools** at the plant areas
- principal decision for final repository research was taken in Parliament, May 2001 (votes 159 – 3) (out of 200)
- the decisions paved the way for OL 3, voting May 2002 in Parliament  
(11 out of 18 ministers that gave green light for OL 3 voted no May 2002)

# ***Olkiluoto 3 EPR***

*(European Pressurized Water Reactor)*

- **TVO biggest shareholders:** Fortum, UPM Kymmene, Stora Enso. Ab. 60 local energy companies involved
- TVO shareholders financing ab. 25 %
- **rest financed by loans at low rate**  
**2,6 %** (Nordea, Handelsbanken, PNB Paribas, JP Morgan, Bayerische Landesbank)
- **Svensk Exportkredit** 1 billion SEK,  
**COFACE** 610 million €

- **biggest reactor in the world: 1.600 MW**
- **prototype for a prototype**
- **ab 1/3 of work force are Finnish**
- **More than half of the contractors and subcontractors are from abroad.**  
Max 25 % of the investments stay in Finland.

- **Parliament discussion 2002:**  
2,3 billion €  
turnkey-price 3,2 billion €  
Price at the moment 5 billions ??
- **Was supposed to go on line 2009**
- **Delay: 2011, 2012, 2013, ?????**
- **International Court process about payments**

## **Kauppalähti 26.2.2010:**

- Prof. Stephen Thomas, Greenwich university (energy research): **If the court procedure between TVO and Areva ends in favour of Areva, TVO might go bankrupt**
- **finally it is the tax payers that will have to pay**
- Stephen Thomas warned about the over-optimistic budget of OL 3 already 2002 when visiting Finland

- STUK has discovered ab **3.000 security and quality problems:**  
Flawed welds for the reactor's steel liner, unusable waterpipes, suspect concrete in the foundation....
- STUK, French ASN and British HSE letter to Areva 22.10.09:  
**declaration with eight comments on the automation based systems**

- **the EPR automation systems, are supposed to take care of the security of the plant if something goes wrong and they are NOT supposed to be depending on the systems functioning when the plant works normally**
- **in fact: in the EPR-reactor there are complexe connections between the control and the security systems**

## *HS 31.1.10, critics from construction workers*

- **4.000 workers from 60 countries**
- problems with languages
- many of the construction workers have not been able to find work elsewhere
- problems: health insurances, health care
- bad salaries – unbelievable stress
- **concrete was laid even though the supporting construction was not ready**

## *Who pays? Kauppalehti Online 11.9.07:*

- Antti Koskelainen, dir. of Elfi:  
(a significant actor in the power market that provides its owners with additional value by having influence on the operation of the market)

**The delay will cost 3 billion € since there will not be cheap nuclear electricity on the markets in time.**

**The Nordic electricity consumers will get a big bill because of the delay**

- **on top of that emission rights have to be bought, 200 million €/year**

*New nuclear power plant  
projects*

*May 2010 government made a principle decision for 2 new plants*

- 3 applications: Fortum, TVO and Fennovoima
- **TVO and Fennovoima were accepted**
- **vote in Parliament 1.7.2010**
- speculations that Fortum will try again later

# Fennovoima:

- **E.on, 34 %.**  
Loviisa city council said no to E.on  
May 2007  
Fennovoima was founded
- 64 shareholders
- **48 domestic energy companies**
- 8 big corporations: **Kesko, Outokumpu, SOK, Rautaruukki, Atria, Myllyn Paras ...**

- **Pyhäjoki:** (ab 25 km south of Raahе)  
North-Ostrobothnian environment bureau (Norra Österbottens miljöcentral)  
4.12.2009: **Hanhikivi is one of the most magnificent nature areas of the coast**
- **Simo:** (ab. 30 km south of Kemi)  
STUK: evacuation planning is challenging. Within 5-6 km big industries, a harbour and a large population. **3.000 within the security zone (law allows max 200)**

## *Reactors built for export of electricity*

- Vattenfall Sähkömyynti, dir. Ilkka Salonen (Yle Hämeen Uutiset 18.2.08):  
**”When the fifth reactor in Olkiluoto is ready there is more production than consumption in the Nordic countries.”**
- Tilastokeskus (Statistics Center):  
**Electricity consumption 2008, 3,5 % lower than 2007**
- Sweden (Miljöaktuellt 16.2.10): Consumption 4 % lower 2009 than 2008

# *Climate and energy strategy of the government 6.11.2008*

- **”When considering a principle decision, nuclear power shall not be built in our country for permanent export of electricity”**
- “Periaatepäätöstä harkittaessa lähdetään kuitenkin siitä, ettei ydinvoimaa rakenneta maahamme sähkön pysyvää vientiä silmälläpitäen”.

# *Aamulehti, 12.3.2010 (Taloustutkimus)*

- **New nuclear power plants:**

**No:**                    **47 %**            (women 64 %)

1 reactor:            22 %

2 reactors:           11 %

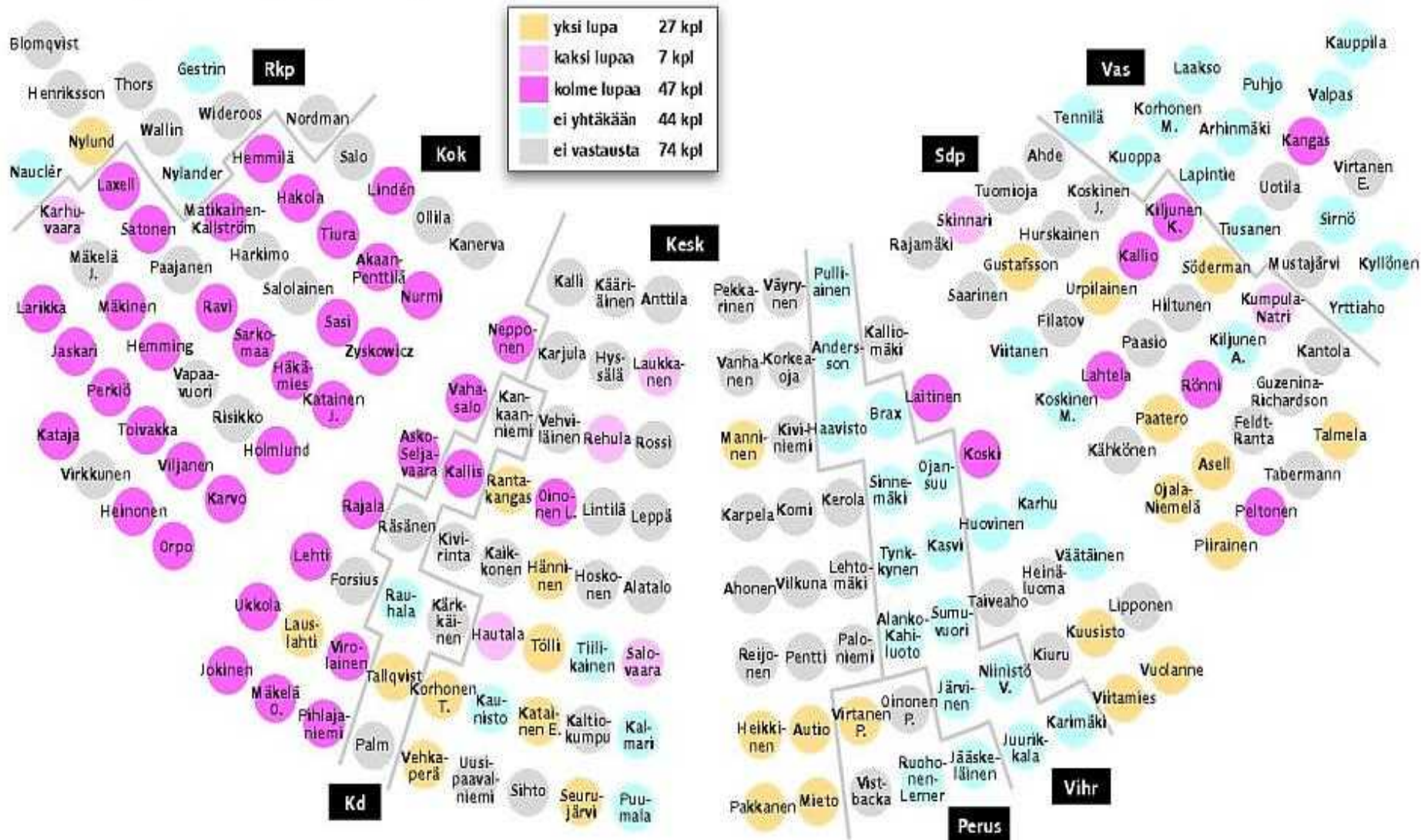
3 reactors:            6 %

? :                      14 %



# HS, 12.3.2010

Kuinka monta ydinvoimalupaa pitäisi myöntää?



*Ilkka column, Matti Kalliokoski, 10.3.2010*

- **Today's nuclear power discussion has got astonishing similarities with Gosplan and the cooperation of the kolchos-managers**
- The whole country and all big players have been recruited for the discussion
- **nuclear power is almost completely meant to cover additional consumption**
- motivation for new plants: top consumption
- nuclear power has constantly the same output. **Tops occur seldomly.** Rest for export.

*Spent fuel*

*Highly radioactive waste*

***US National Academy of Sciences,  
Environment News Service 9.8.2005***

- **the most dangerous peak radiation levels from nuclear waste isotopes would persist for 300,000 years**
- **one million years is cited as providing a reasonable basis for projecting the performance of the disposal system**
- **one million years=25.000 generations**

# *Sachverständigenrat für Umweltfragen*

## *"Umweltgutachten 2000"*

*(German council of environmental experts)*

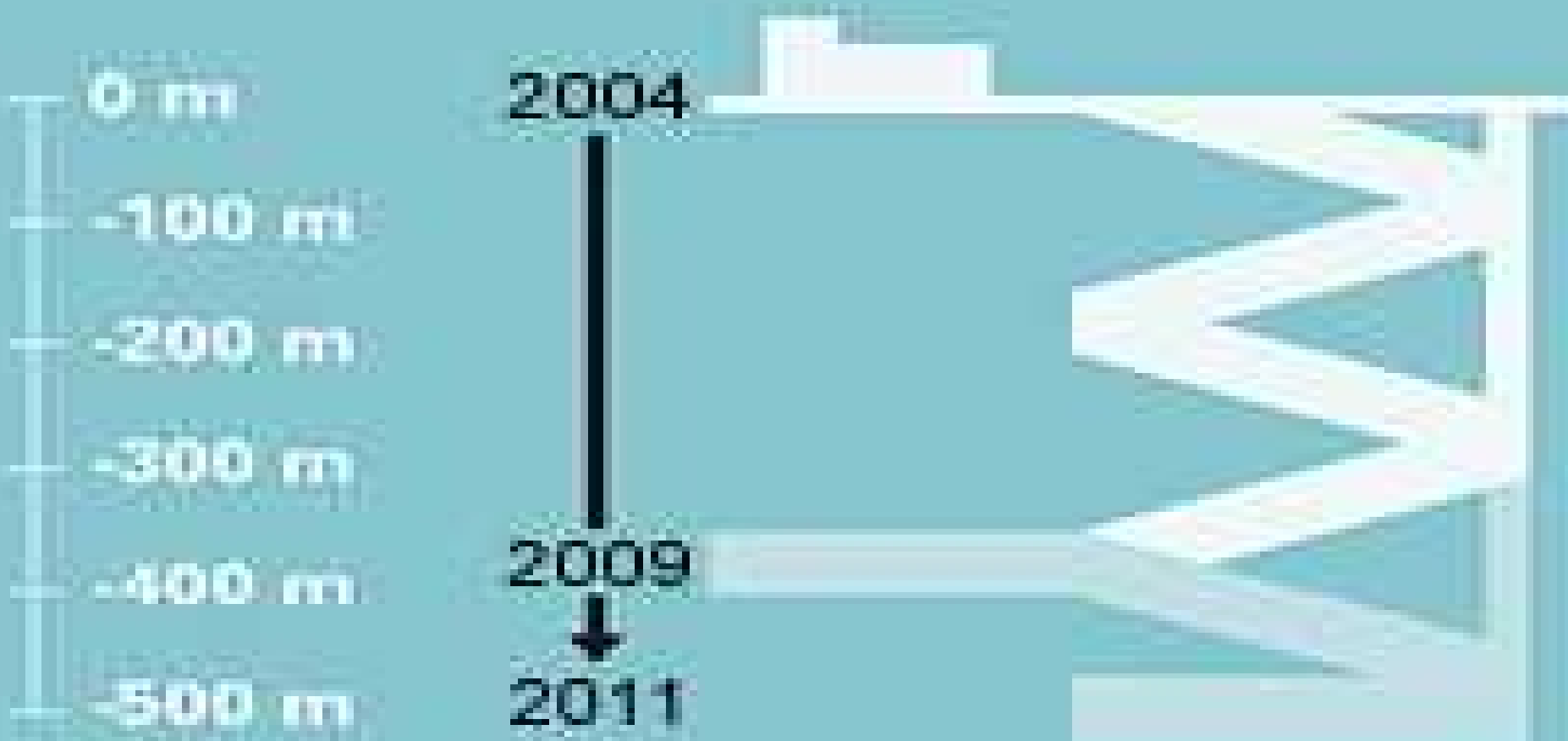
- **it is practically out of the question to give a security guarantee covering more than 10.000 years**
- research done to find a suitable final repository has never come to any scientific indisputable evidence for an absolutely secure solution
- the council: a further use of nuclear power is irresponsible

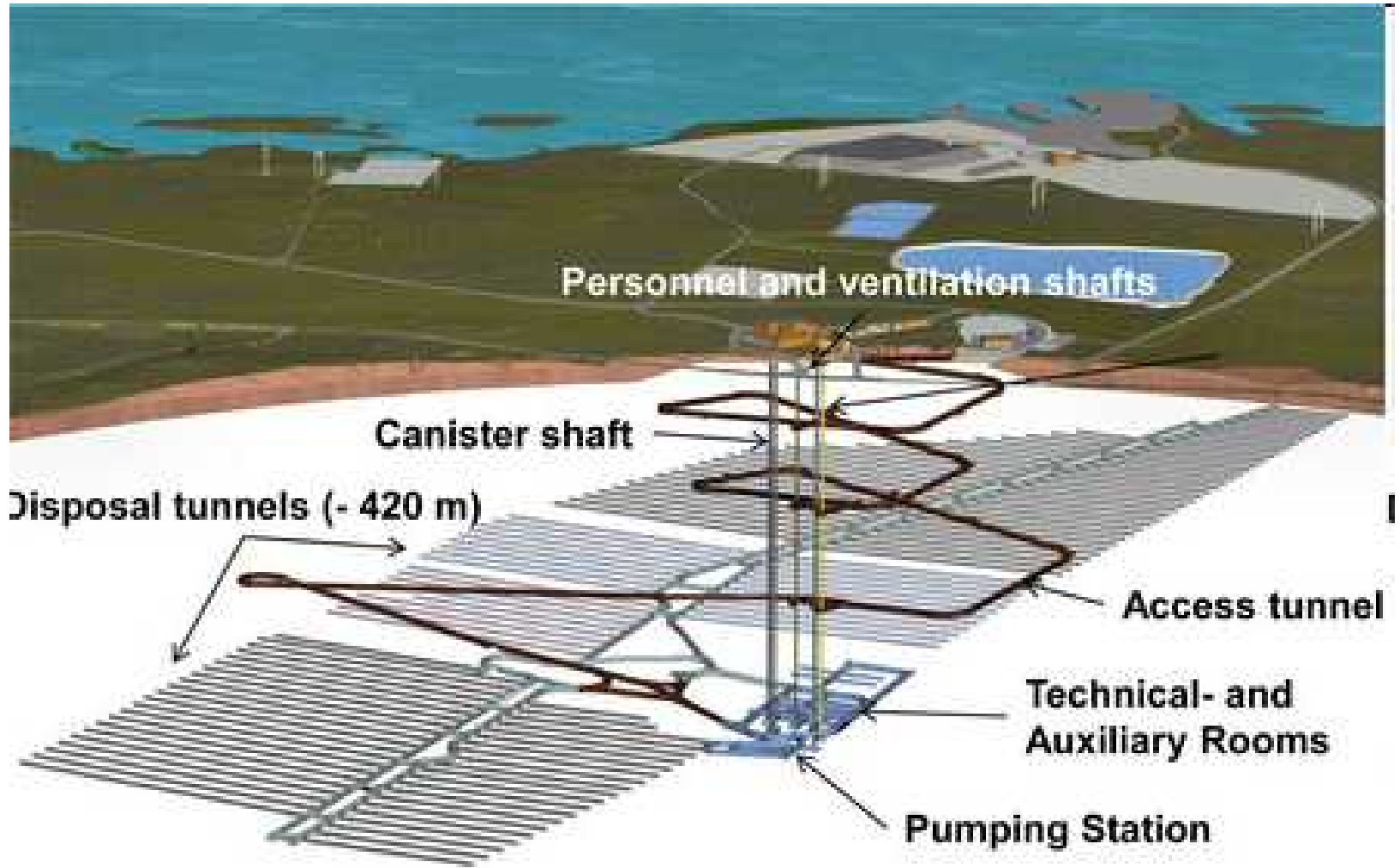
*There is no final repository for spent fuel anywhere in the world – will Finland get the first one?*

- the principal decision for building a final repository was taken in Parliament, May 2001 (votes 159 – 3) (out of 200)
- repository is being built in Olkiluoto (Onkalo) by Posiva - company responsible for nuclear waste

- **the model has been developed by Posiva and the Swedish waste company SKB** (Svensk Kärnbränslehantering)
- the method runs under the title **KBS-3**
- **it is a 30 year old project**
- **security shall be guaranteed for 100.000 years**
- according to Posiva and SKB the waste has during this period of time to be isolated from human beings and environment

- **planned depth of the repository:  
about 450 metres**
- research project in Olkiluoto has now reached some 420 metres
- according to Posiva **construction permit application is on its way. Planned for 2012**  
**(deadline 2016, principle decision of parliament expires)**





## *SKB information*

- tunnels will be ab. 250 m long
- tunnels positioned ab 40 metres apart
- disposal holes ab 6 (10) metres apart
- the copper canisters will be placed in the disposal holes and embedded in a bentonite-clay buffer
- **the tunnels and shafts will be filled in with swelling clay or a mixture of crushed rock and clay**

Cladding tube

Spent nuclear fuel

Bentonite clay

Surface portion of deep repository

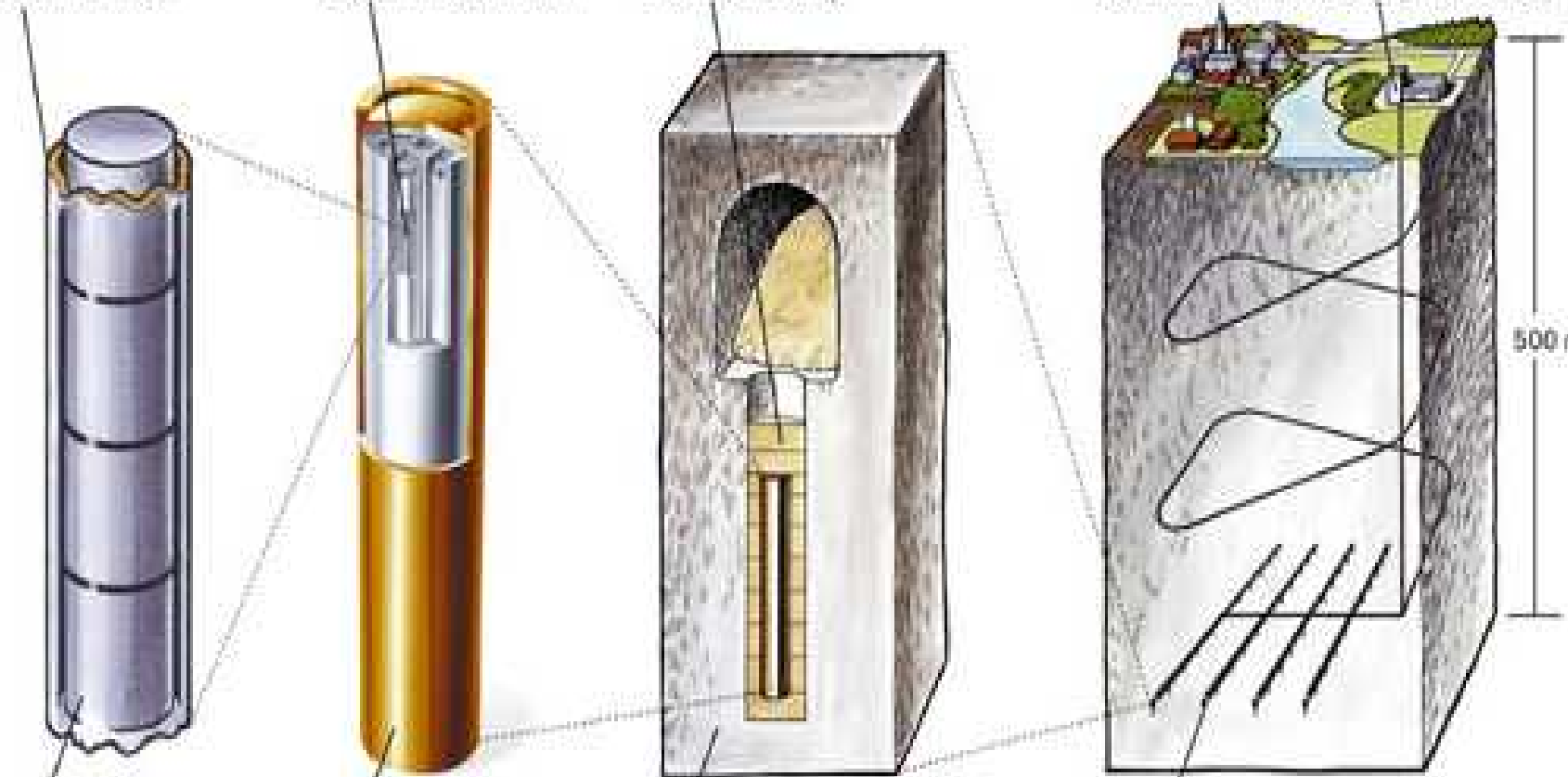
Fuel pellet of uranium dioxide

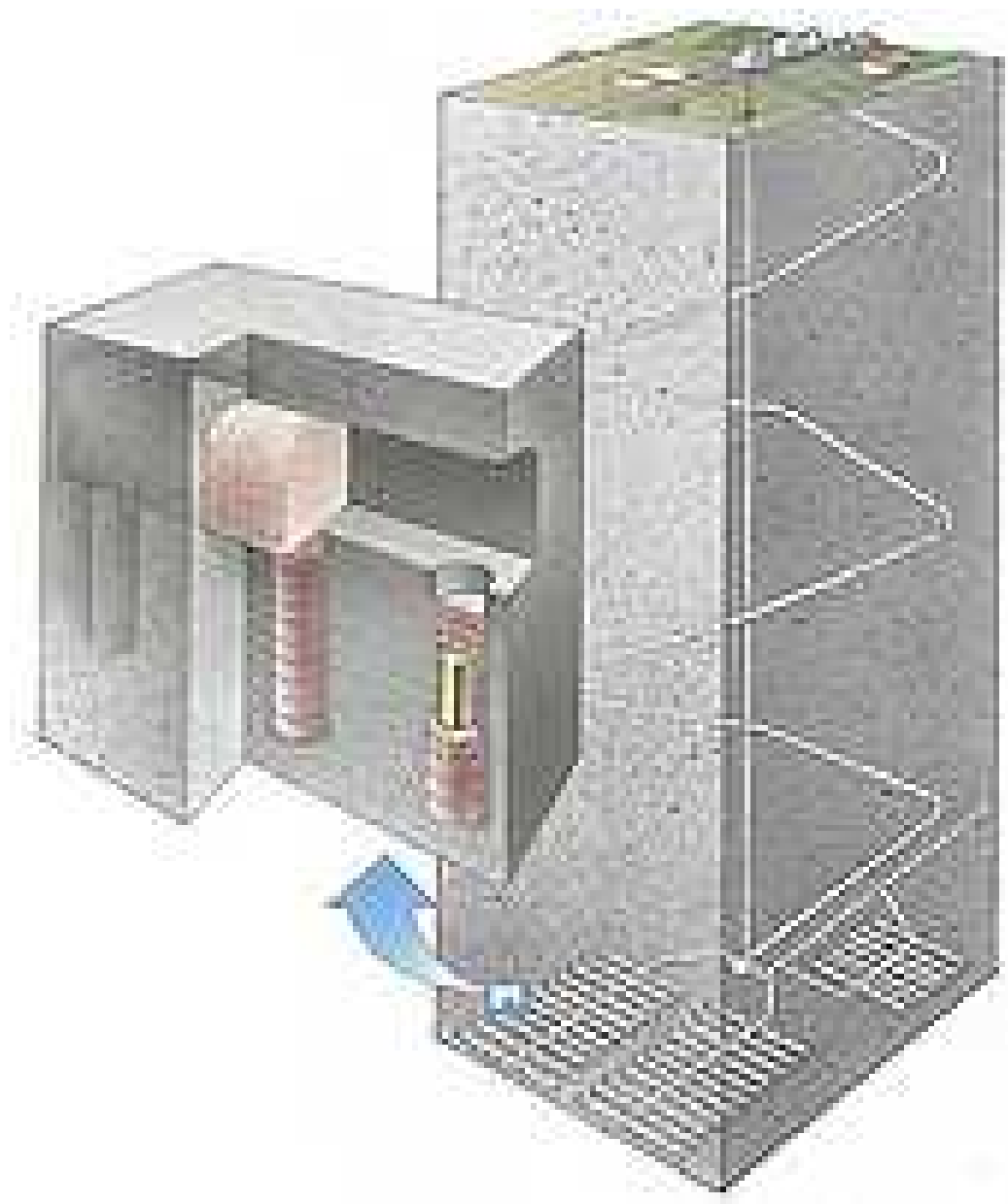
Copper canister with cast iron insert

Crystalline bedrock

Underground portion of deep repository

500 m







## *Ny Teknik, the Copper Canisters might break within 1.000 years, 7.10.2009*

- in September 2009 Peter Szakálos and 12 other scientists from Sweden, Canada, Russia and Singapore published a report based on studies with copper coins from the Wasa ship that sunk in 1628
- the coins have corroded almost completely

- the scientists warn that the copper layer of 5 cm is too thin
- it was originally planned to be 20 cm but the copper would then be more complicated to handle and copper is expensive
- **the copper layer would have to be one meter thick to manage 100.000 years**
- the environment in Forsmark at the Baltic Sea/Gulf of Botnia is almost similar to the Wasa ship environment

## *Ny Teknik, 12.2.2010*

- Swedish National Council for Nuclear Waste (Kärnavfallsrådet)
- **demands new studies about the security of the copper canisters**
- **demands higher quality of bentonite clay**
- demands discussion about retrievability of the waste

*Karl-Inge Ahäll, professor of bedrock-geology, Karlstad University, Sweden  
March 2008*

- if there is a leakage in the KBS-repository at 500 m depth the radioactive substances would move fast towards the surface of the ground via the moving groundwater
- **research should be made about 3-5 km deep boreholes**

*Leif Bjelm, professor of technical geology, Lund University, Sweden, March 2008*

- SKB (the company in charge of spent fuel in Sweden) has not considered the development in drilling techniques that has taken place during the last few years
- **it is not difficult these days to drill such deep holes that would be suitable for spent fuel**

*Nils-Axel Mörner, Head of Paleogeophysics & Geodynamics at Stockholm University (1991-2005)*  
*speech November 2007*

- the idea of a “final deposition” came out of an utterly wrong and old geological picture of the late 1970ies
- **today, we know there is no “safety” to lean on in the perspective of 100.000 years or so**

- on the opposite, we now know that **Fennoscandia was a high-seismic area after the Ice Age**, with fault displacements, bedrock fracturing and methane explosions
- **we can no longer talk about a long-term safety of a KBS-3 repository; at least not with an anchoring in modern geoscientific achievements**

- **instead a dry deposition, the DRD method, is advocated**
- it gives freedom of action
- the waste is controllable, retrievable, reparable, usable, and moveable
- besides, this method is much cheaper
- (it is generally admitted that there will be at least one ice-age in Scandinavia within the next 100.000 years)

## *A problem not being discussed at all*

- **EPR design envisage burn-up rates of 60 (70) GWd/tU (gigawatt-days per ton of uranium)**
- at these rates, uranium fuel rods should burn for around a year longer than today's best burn-up fuel
- this gives more output from the fuel, but causes spent fuel more hazardous and problematic to manage

*New Scientist, Nuclear super-fuel gets too hot to handle, Rob Edwards, 14.4.2008*

- when you make uranium burn stronger, hotter, longer in nuclear reactors, you'll need less fuel and there'll be less waste to deal with
- this high-efficiency fuel may prove to be unstable in an emergency, and so it poses a **greater risk of leakage of radioactive material into the environment**

*New Scientist cont..*

- **the waste fuel is more radioactive. It could prove even more difficult than existing waste to store in underground repositories**
- According to Nirex, until 2006 responsible for dealing with UK's nuclear waste, **fuel with a burn-up of 55 GWd/tU would be around 50 per cent more radioactive than burn-up fuel of 33 GWd/tU throughout the time it needs to be stored.**

## *New Scientist cont...*

- **to keep the build-up of heat within safe limits, spent elements of higher burn-up fuel will have to be stored further apart**
- the build-up of heat could cause fractures in the containers in an underground repository or in the surrounding rock, and increase the risk of a leak
- increased efficiency of high burn-up fuel means less of it, but more storage space will still be required overall

*IAEA guidebook published September 2007 (Higher burnup of fuel, Selection of Away-From-Reactor Facilities for Spent Fuel Storage, Tecdoc1558)*

**”The higher burnup of fuel has a significant impact on the choice of the storage option and on the design of storage systems, due to the increased decay heat, inter-alia, which is roughly proportional to burnup, imposing a higher cooling load to the storage system.”**

***Nuclear Waste Advisory Associates,  
UK, 29.1.2010***

***Submission to the House of Commons Energy and  
Climate Change Committee Inquiry into the  
Energy National Policy Statement***

- **NWAA: independent group of experts with over 200 years collective experience of nuclear issues**
- **‘high burn up’ fuel is hotter and more radioactive and unlike**

## *Nuclear Waste Advisory Associates cont...*

- **Such waste fuel would require longer storage at the reactor site and would be more fiercely radiotoxic**
- Resolution of the problems raised by for instance the EA (Environment Agency) and EU JRC (Joint Research Centre), is not a simple matter of providing sufficient funding for researchers over the next few decades

## *Nuclear Waste Advisory Associates cont...*

- **it may, in fact, not be possible to resolve all of the issues**
- further research may not produce the required answers or it may identify further serious problems that had not previously been realised
- **it may not be possible to make a safety case for deep geological disposal**

***Dr Johan Swahn, the Director of MKG,  
Sweden, December 2009***

(Miljöorganisationernas kärnavfallsgranskning)



**“There is no way that anyone can honestly claim that Posiva has a completed robust safety case. The Posiva safety case has not been developed independently, but relies entirely on the Swedish safety case work. The final test of the Swedish safety case will not be done until the Swedish Radiation Safety Authority gives an approval of the safety analysis... This will not be the case before 2013-2014.”**



Aftonbladet  
Fredag 13 februari 2009

## *Las Vegas Review-Journal, 30.1.2010*

- **"The debate over Yucca Mountain is over, as the president has made clear many times,"** said Carol Browner, director of the White House Office of Energy and Climate Change Policy
- **Lee Hamilton** (chair of a 15-member panel of experts to chart new paths to manage highly radioactive nuclear waste) **"the idea of storing, and ultimately burying, nuclear spent fuel underground is outdated"**

*proliferation*

## *The Age, 17.11.2006*

**Al Gore**, former US vice-president, one of the world's most celebrated climate change campaigners:

- "nuclear energy is not the panacea for tackling global warming"
- "for eight years when I was in the **White House, every problem of weapons proliferation was connected to a reactor program"**

## *Reuters 4.5.2010*

- **IAEA director general Yukiya Amano told a meeting to discuss NPT: more than 60 countries consider using nuclear power to generate electricity (32 countries 2009)**
- **10-25 new countries expected to bring their first plants online by 2030**
- **nuclear power must be accessible also for developing countries**

## *Thomas B Cochran, from Natural Resources Defense Council (US)*

*(Dr. Cochran has been a member of numerous government advisory committees on nuclear energy, nonproliferation and nuclear clean-up issues)*

- **on average, a 1000 MWe LWR discharges spent fuel containing about 200 kg of plutonium per year**
- **the actual value for any reactor may differ, it depends upon the fuel burnup**
- **enough for some 40 nuclear bombs**
- (March 2009: 436 reactors in the world)

*foreign waste to Finland?*

## *Fennovoima – no final repository plans*

- Kaleva 20.5.10, **Jorma Aurela, ministry of employment and economy**: there are many options for final repositories in case the company builds a repository of its own. 6 years after parliament has ratified the principle decision Fennovoima has to specify the plans.

*YLE, 22.4.2010*

- **STUK, Jukka Laaksonen: recommends final repositories at the location of the nuclear power plant**
- already when STUK looked for a repository site for Olkiluoto nuclear waste, **350 suitable bedrock sites were found in Finland**
- **i.e. in almost every commune in Finland a suitable place for a nuclear waste final repository can be found**

- **Mauri Pekkarinen warned in Uusi Suomi 20.8.08: nuclear electricity production for export might oblige Finland to receive foreign nuclear waste**
- **Ilkka Salonen, dir. of Vattenfall Sähkömyynti (YLE 18.2.08): when OL 3 is going on line the electricity production exceeds consumption in the Nordic countries**

*IAEA, rapport Multilateral Approaches to the Nuclear Fuel Cycle (feb. 2005)*

- common worldwide final repositories (9)

*Andris Piebalgs, energy comm. february 05 (SPEECH/05/122):*

- ”The second area to be addressed by the Joint Undertaking is that of geological disposal. I am not advocating new research into the technology itself, but **research on the suitability of very specific sites or geological formation to act as a host for a repository...**”

# *German Capital business magazin*

*4.10.2009:*

- ”what to do with radioactive waste from German nuclear power plants?
- **Olkiluoto mentioned as a suitable place – for a suitable payment**
- nuclear friendly climate, scarce population, the poor economic situation in the area

## *AGM of E.ON in Essen in May 2007*

- CEO Wulf Bernotat answered a question concerning spent fuel
- if E.ON produces spent fuel in Finland it will be finally disposed of in Finland
- **concerning spent fuel produced elsewhere by E.ON he stated that this is a political question to be solved in Finland**

*Per Cramér, prof. EC- and international law,*

*Göteborgs handelshögskola*

*Göteborgs-Posten 20.6.2005*

- **declaration of Sweden (Finland) before joining the EU1994 - not accepting intermediate or final disposal of foreign nuclear waste on Swedish ground**
- **naive to believe the declaration would have any legal value.** Discriminating to forbid free movement of services and goods on the basis of national interests.
- utmost important to get at least a political confirmation about the legal status of the declaration.

*Göran Sundqvist, sociologist at the  
university of Gothenburg, SR 12.6.08*

- has followed the waste question 15 years
- **”Forsmark might become the final repository of Europe”**
- even if Swedish law today prohibits such a solution the question will become extremely important in EU in the near future
- EU would be stupid if it would deal with this matter by force and directives. Instead **it is very likely that they will call for common responsibility and co-operation**

*Uranium - the devil's death  
stone*

## *Plans for uranium mining in Finland*

- **Talvivaara, mainly producing nickel and zinc has asked for permission to start uranium mining**
- **mining concessions in Finland 12.1.10: Areva (Joensuu/Kontiolahti), Karelian Resources (Salla/Joensuu), Mawson (Paltamo/Joensuu)**
- **mining concession applications 7.1.10: Areva (Rovaniemi/Ranua/Ylitornio), Mawson (Tervola/Nilsinä)**

## *Mawson press release 30.4.2010*

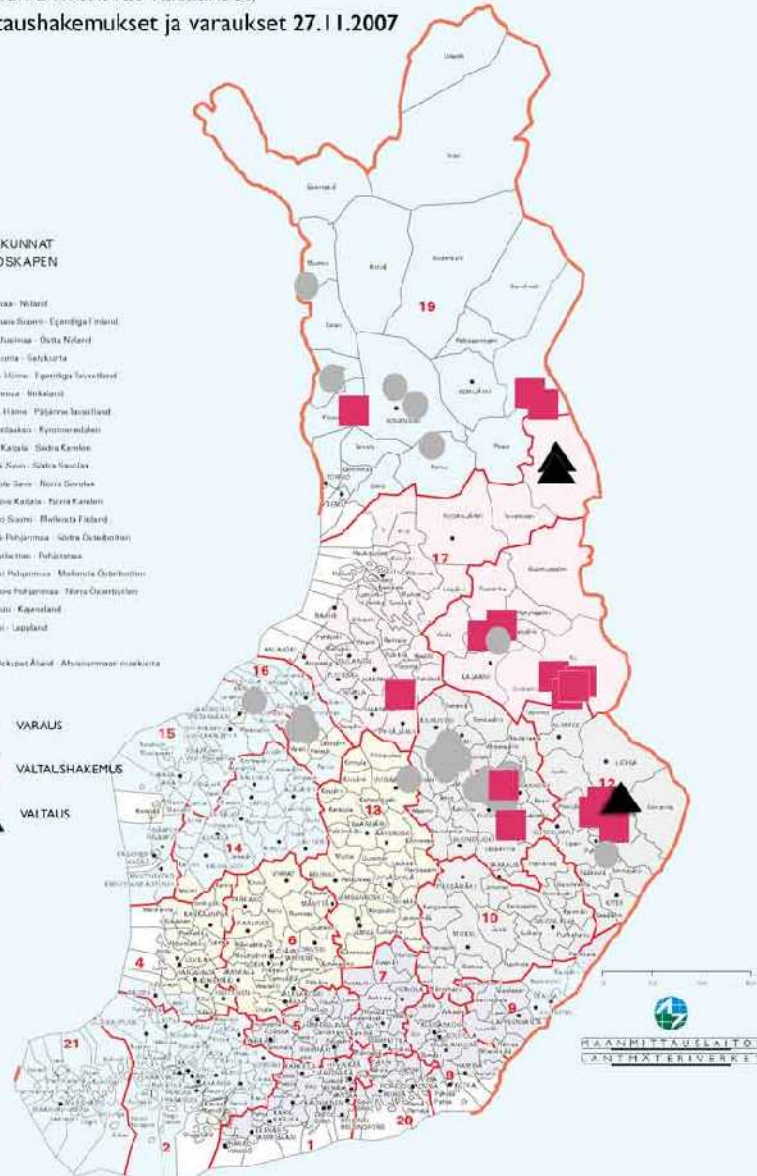
- **Mawson to acquire 100 % of Areva's Finnish uranium exploration portfolio**, as well as the database developed over 10 years of exploring in the country
- south eastern Finland 790 hectares
- north central Finland: 11.872 hectares + 3.556 hectares
- Areva will hold 11 % of Mawson + right to additional 8 %

Uraania koskevat valtaukset,  
valtaushakemukset ja varaukset 27.1.2007

MAAKUNNAT  
LANDSKAPEN

1. Luomaa - Wästan
2. Varsinais-Suomi - Egentliga Finland
20. Häj-Juonia - Östra Nyland
4. Satakunta - Satakunta
5. Keski-Häme - Förenings län
6. Pohjanmaa - Björneborg
7. Päijät-Häme - Päijätne län
8. Kymenlaakso - Kymmenedalen
9. Etelä-Karjala - Södra Karelen
10. Etelä-Savo - Södra Savolax
11. Pohjois-Savo - Norra Savolax
12. Pohjois-Karjala - Norra Karelen
13. Keski-Suomi - Mellersta Finland
14. Etelä-Pohjanmaa - Södra Östern
15. Oulu - Uleåborg
16. Keski-Pohjanmaa - Mellersta Östern
17. Pohjois-Pohjanmaa - Norra Östern
18. Kanta-Häme - Kanta-Häme
19. Lappi - Lappland
21. Länneknuta - Abiskoområdet

-  VARAUS
-  VALTAUSHAKEMUS
-  VALTAUS

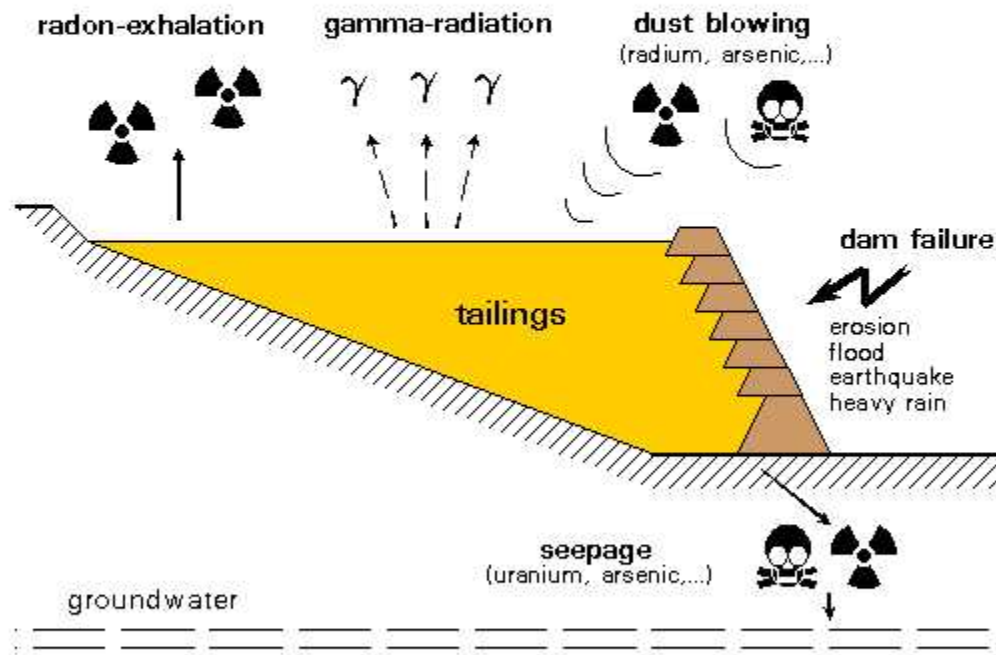


*the Guardian, 5.12.08, Extracting a disaster*

- **25 t of uranium fuel is needed for and average reactor yearly**
- **this means half a million t of waste rock + 100 000 t of mill tailings**
- **toxic for hundreds of thousands of years**
- **the conversion plant generates another 144 t of solid waste and 1.343 m<sup>3</sup> of liquid waste.**

# Restprodukter

## Uranium Mill Tailings Hazards



<http://www.wise-uranium.org>  
WISE World Information Service on Energy



Quirke tailings, Elliot Lake, Ontario, Canada, 1999 (Rio Algom Ltd.)





**Who pays for an accident ?**

## *New law regarding responsibility for nuclear accidents must come into force*

- Parliament accepted, and the president confirmed 2005 the new nuclear responsibility law
- the owner of the nuclear plant has to cover the costs for a big accident by its possessions

## However:

- the first 700 million € would be covered by plant operator insurance
- for the amount exceeding this, **the state is responsible for 500 million €**
- **the next 300 million € will be covered by all the states signing the international agreement**
- for the amount exceeding the first 1,5 billions the plant operator has an unlimited responsibility

## *The state of today*

- **the law in force: the responsibility of the energy company covers 200 million €**
- **the rest has to be covered by the state = the taxpayers**
- costs for Chernobyl mentioned at the UN homepage amount to 440 billion USD. Real price ???

- **Germany:** the nuclear energy companies all together responsible for 2,5 billion €. Rest to be covered by the plant owner
- **Japan and Switzerland:** unlimited responsibility. US 10 billion €
- **Belgium, next in line for EU presidency (1.7.10), has announced that it will push for the Paris treaty to be ratified in all EU-countries**

# Nuclear Power Plants in the Baltic & Barents Region



## Status of NPP reactors

- |                                  |                             |                                |
|----------------------------------|-----------------------------|--------------------------------|
| ▲ operable                       | △ planning of construct     | — divide                       |
| △ adopted the polotical decision | ▲ stopped or decommissioned | — national borders             |
|                                  | ▲ prolonged                 | ▬▬▬ planning electricity cable |

